Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Drilling Hydraulics **Semester: IV**
Program: B.Tech APE UP **Time 03 hrs.**
Course Code: PEAU 2003 **Max. Marks: 100**

SECTION A

S. No.		Marks	CO
Q 1	Explain in general terms, graphically and mathematically the: Newtonian Power Law and Bingham Plastic rheological Models?	**4**	**CO3**
Q 2	Describe the factors which influence the pressure drop in a drilling system?	**4**	**CO2**
Q 3	Describe in general terms, the factors which influence the pressure drop across a nozzle?	**4**	**CO5**
Q 4	Explain the technique for determining the optimum hydraulics at a drill bit using the hydraulic horse power criteria?	**4**	**CO4**
Q 5	List and describe the functions of drilling fluids and the properties which influence the capability of the fluid to achieve these functions?	**4**	**CO1**

SECTION B

Q 6	Determine the slip velocity and transport velocity for the following well data: Depth = 9000 ft. Hole Diameter = 12.25 inch. Drill Pipe = 5 inch/4.276 inch. Flow Rate = 500 gpm. Mud density = 10 ppg. Density of rock = 21 ppg. Average particle size = 0.28 inch. Viscometer readings: $\theta_{600}=90$ $\theta_{300}=50$	**10**	**CO5**
Q 7	Determine surge pressure for plugged pipe: Date: Well depth = 15,000 ft Hole size = 7-7/8in. Drill pipe OD = 4-1/2in. Drill pipe ID = 3.82in. Drill collar = 6-1/4" O.D. x 2-3/4" ID Drill collar length = 700ft Mud weight = 15.0 ppg Viscometer readings: $\theta_{600}=140$ $\theta_{300}=80$ Average pipe running speed = 270 ft/min	**10**	**CO6**

<table>
<tr><td>Q 8</td><td>a. Calculate the velocity of a fluid flowing through a 5" 19.5 lb/ft drill pipe (I.D.= 4.276") at 150 gpm?
b. Determine the pressure loss in the above situation if the fluid is a Bingham Plastic fluid with a plastic viscosity of 20 cp, a yield point of 15 lb/100 sq. ft and density is 100 ppg?
c. Calculate the Pressure loss in the above situation if the fluid was a power law fluid with a non Newtonian index of 0.75 and a consistency index of 70eq cp.</td><td>2+4+4</td><td>CO2</td></tr>
<tr><td rowspan="3">Q 9</td><td>Prove that the effective viscosity in imperial units for an annular flow obeying a power law model is given by
$\mu_e = 200\,K\left(D_h - D_p\right)\left[\frac{0.8}{\left(D_h - D_p\right)}\left(\frac{2n+1}{n}\right)\right]^n V^{n-1}$</td><td>10</td><td rowspan="3">CO3</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>Prove that the effective viscosity in metric units for a mud flow through drill pipe obeying Bingham plastic model is given by
$\mu_e = PV + 0.0798\left(\frac{D}{V}\right)YP$</td><td>10</td></tr>
<tr><td colspan="4">SECTION-C</td></tr>
<tr><td>Q 10</td><td>a. Describe the equipment and procedures used to determine the: density; rheological properties; gel strength; filtration properties; sand content and pH?
b. Determine the quantity of barite required to change the density of mud from 12.53 ppg to 16.7 ppg. Calculate the increase in pit volume due to the addition of such a quantity of barite for an initial mud volume of 10 m^3.</td><td>15 + 5</td><td>CO1</td></tr>
<tr><td>Q 11</td><td>Determine the proper pump operating conditions and bit nozzle sizes for maximum jet impact force for the next bit run, using graphical analysis. The bit currently in use has three 12/32-in nozzles. The driller has recorded that when the 9.6lbm/gal mud is pumped at a rate of 485 gal/min, a pump pressure of 2800 psig is observed and when the pump is slowed to a rate of 247 gal/min, a pump pressure of 900 psig is observed. The pump is rated at 1,250 hp and has an efficiency of 0.91. The minimum flow rate to lift the cuttings is 225 gal/min. The maximum allowable surface pressure is 3000psig. The mud density will remain unchanged in the next bit run.</td><td>20</td><td>CO6</td></tr>
</table>

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SECTION A

S. No.		Marks	CO
Q 1	Explain the impact of hydraulic horse power on the penetration of a drill bit?	4	CO5
Q 2	Discuss the rheological models which best describes the various types of drilling fluids and cement slurries?	4	CO2
Q 3	What are the suitable optimizing methods in bit hydraulics?	4	CO6
Q 4	Describe the equations and the influential factors involved in the calculation of pressure drop of Bingham plastic fluid in drill pipe?	4	CO3
Q 5	Describe the most important properties of drilling fluids?	4	CO1

SECTION B

Q 6	Determine the slip velocity and transport velocity for the following well data: Depth = 9000 ft; Hole Diameter = 12.25 inch. Drill Pipe = 5 inch/4.276 inch; Flow Rate = 500 gpm. Mud density = 10 ppg; Density of rock = 21 ppg. Average particle size = 0.28 inch; Viscometer readings: $\theta_{600}=90$; $\theta_{300}=50$	10	CO5
Q 7	Define Swab and Surge Pressure. Also determine both the surge and swab pressure for the data listed below: Data: Mud weight = 15.0 ppg; Plastic viscosity = 60 cP. Yield point = 20 lb/l00 sq ft; Hole diameter = 7-7/8 in. Drill pipe OD = 4-1/2 in., Drill pipe length = 14,300 ft Drill collar OD = 6-1/4 in., Drill collar length = 700 ft Pipe running speed = 270 ft/min.	10	CO6
Q 8	a. An upper plate of 20 cm^2 area is spaced 1 cm above a stationary plate. Compute the viscosity in centipoise of a fluid between the plates is a force of 100 dyne is required to move the upper plate at a constant velocity of $10\frac{cm}{sec}$. b. An upper plate of 20 cm^2 area is spaced 1 cm above a stationary plate. Compute the yield point and plastic viscosity of a fluid between the plates if a force of 200 dynes is required to cause any movement of the upper plate and a force of 400 dynes is required to move the upper plate at a constant velocity of $10\ \frac{cm}{sec}$.	5 + 5	CO3
Q 9	Prove that the effective viscosity in imperial units for an annular flow obeying a power law model is given by		CO3

	$\mu_e = 200\,K\left(D_h - D_p\right)\left[\frac{0.8}{\left(D_h - D_p\right)}\left(\frac{2n+1}{n}\right)\right]^n V^{n-1}$	**10**	
	(OR)		
	Prove that the effective viscosity in metric units for a mud flow through drill pipe obeying Bingham plastic model is given by $\mu_e = PV + 0.0798\left(\frac{D}{V}\right)YP$	**10**	
	SECTION-C		
Q 10	a. Retort Analysis Data: % by volume oil = 51; % by volume water=17;% by volume solids = 32. Calculate: a) The Oil/Water Ratio. b) Volumes of oil and water, if the ratio is increased to 80/20. c) Volumes of oil and water, if the ratio is decreased to 70/30. b. After setting a casing string at 10,000 ft, it is necessary to increase the density of 900 bbls of mud in the surface pits from 16 ppg to 17.5 ppg. The volume fraction of low density solids must also be reduced from 5.0 % to 3.0 %, by dilution with fresh water. A final volume of 900 bbls is required. i. What volume of mud should be discarded? ii. How much water must be added? iii. How many sacks of barite are required? (Assume density of barite is 35 lb/gal, density of water is 8.33 lb/gal, and one sack of barite is 94 lbs).	**10 + 10**	**CO1**
Q 11	Optimize bit hydraulics on a well by selecting proper jet sizes for impact force and hydraulic horsepower for two jets and three jets with the following data: Mud weight = 13.0 ppg Maximum surface pressure = 3000 psi Pump pressure 1 = 3000 psi Pump rate 1 = 420gpm Pump pressure ***2*** = 1300 psi Pump rate 2 = 275 gpm.	**20**	**CO6**